PhytoKeys 186: 159–167 (2021)
doi: 10.3897/phytokeys.186.77575
https://phytokeys.pensoft.net

SHORT COMMUNICATION

A peer-reviewed open-access journal
PhytoKeys
Launched to accelerate biodiversity research

Phelypaea boissieri f. *lutea* (Orobanchaceae), a peculiar new form from Turkey and typification of the name of this species

Ümit Subaşı[1], Óscar Sánchez Pedraja[2], Renata Piwowarczyk[3]

1 *Ege University Faculty of Sciences, Department of Biology, 35100, İzmir, Turkey* **2** *Grupo Botánico Cantábrico, ES-39722 Liérganes (Cantabria), Spain* **3** *Center for Research and Conservation of Biodiversity, Department of Environmental Biology, Institute of Biology, Jan Kochanowski University, Uniwersytecka 7, PL-25–406 Kielce, Poland*

Corresponding author: Renata Piwowarczyk (renata.piwowarczyk@ujk.edu.pl)

Academic editor: E. Fischer | Received 3 November 2021 | Accepted 22 November 2021 | Published 9 December 2021

Citation: Subaşı Ü, Sánchez Pedraja Ó, Piwowarczyk R (2021) *Phelypaea boissieri* f. *lutea* (Orobanchaceae), a peculiar new form from Turkey and typification of the name of this species. PhytoKeys 186: 159–167. https://doi.org/10.3897/phytokeys.186.77575

Abstract

The genus *Phelypaea* includes three holoparasite species with one of the most intense red flowers among all plants worldwide. So far, there are few references to other colour taxa of this genus. We describe a new yellow-coloured form, *Phelypaea boissieri* f. *lutea*, from Hakkari province in the Cilo Mountains of SE Turkey, found at an altitude of 2,470 m. In typical *P. boissieri*, here typified by us, the flowers are deeply red, and stems, calyx and scales are red to brown, or rarely pale-brown, whereas in the entire population of f. *lutea* the corolla, calyx, and scales are yellow to orange with black folds in the corolla, while only the stem is brownish.

Keywords

Forma nova, lectotype, Orobanchaceae, *Phelypaea*, SE Turkey, synonyms, typification

Introduction

The genus *Phelypaea* L. (≡ *Diphelypaea* Nicolson, nom. illeg.) (Orobanchaceae) includes three holoparasite species: *P. coccinea* (M. Bieb.) Poir., *P. boissieri* (Reut.) Stapf, and *P. tournefortii* Desf., whose parasitise Asteraceae hosts. *P. coccinea* occurs in the

Copyright Ümit Subaşı et al. This is an open access article distributed under the terms of the Creative Commons Attribution License (CC BY 4.0), which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Caucasus and Crimea, and is a parasite of *Psephellus* Cass. and *Centaurea* L., rarely *Klasea* Cass., while *P. tournefortii* occurs in the Caucasus and Turkey, and is a parasite of *Tanacetum* L. (Sánchez Pedraja et al. 2016; Piwowarczyk et al. 2019). Meanwhile, *P. boissieri* shows a different distribution; it occurs in the Balkans (Albania, Greece, North Macedonia), and Western Asia (Turkey, Iraq and Iran), and parasitises *Centaurea* and occasionally *Cousinia* Cass. in Iraq (Sánchez Pedraja et al. 2016; Piwowarczyk et al. 2019). *P. boissieri* is molecularly, morphologically and regarding host preferences similar to *P. coccinea* (Piwowarczyk et al. 2019, 2021). The morphological features that separate *P. boissieri* and *P. coccinea* are as follows: corolla - tube short and cup-shaped; corolla - lobes broadly obovateorbicular to orbicular, overlapping; anthers - hairy (Stapf 1915; Nicolson 1975; Cullen 2010); however, sometimes apparently intermediate features are also observed (Piwowarczyk et al. 2019). Therefore, further research into the variability of *P. boissieri* and the inclusion of more samples for molecular analysis are required (Piwowarczyk et al. 2021).

Species from the genus *Phelypaea* are achlorophyllous and possess one of the most intense red flowers among all plants worldwide. A recent study on *P. tournefortii* showed that anthocyanins were found in unprecedented large quantities in the flowers, as well as large amounts of polyphenols, especially eukovoside (Piwowarczyk et al. 2020).

So far, there have been few references to colour forms other than red in the genus *Phelypaea* in the literature. One of them is *P. coccinea* f. *aurantiaca* Beck in Engl., Pflanzenr. 96: 261 (1930), which was described from Karabakh in the Caucasus based on material collected by Radde as having an orange corolla ("aurantiaco"). Another non-red colour form is *P. helenae* Popl., described from Alushta in Crimea ("corolla orange-yellow") and, according to Novopokrovsky and Tzvelev (1958: 28), it is synonymous with the species mentioned before and does not constitute a different species (but rather a case of polychromism) with regard to *P. coccinea* ("corolla bright-red"), and both yellow and red forms occur together in Crimea. In *P. coccinea*, sometimes the corolla in the lower-side is orangish or yellow, with the upper side in the typical red color preserved (Piwowarczyk et al. 2019). Within one population, there may be individuals with a corolla which is red on both sides, as well as with one yellow-orange side.

In this paper, we typify *P. boissieri* and indicate its synonyms, and besides, describe a new yellowish-coloured form from Turkey.

Typification of *Phelypaea boissieri*

Phelypaea boissieri (Reut.) Stapf in Bull. Misc. Inform. Kew 1915, 6: 291 (1915 [17 Aug 1915]).

Basionym: *Anoplanthus biebersteinii* var. *boissieri* Reut. in DC., Prodr. 11: 42 (1847 [25 Nov 1847]).

Type: lectotype (here designated): 1. "*Orobanche* / Cadmus [Mount Cadmus / Topçambaba Dağı / Baba Dağı / Baba Dagh, Aydın Province? or, more likely, mont Honaz / mont Cadmus / Honaz Dağı, Denizli Province?] ad or. Denisleh [to the east

Denizli] Jun" [m. Boissier]. – 2. "*A. coccineus*". – 3. "Syntypes / *Anoplanthus biebersteinii* / var. *boissieri* Reut." (G-Boiss G00150150 [Fig. 1, the sheet contains four specimens, the lectotype is formed by the three specimens of a single gathering, located in the lower left of the sheet]).

Isolectotypes: idem (G-Boiss G00150150 [Fig. 1, the isolectotype is a single specimen in the upper right corner]); "*Anoplanthus biebersteinii* var. *boissieri* Reut. / Cadmus supra Denisleh [Denizli], ad *Centaurea* / *Boissier*, [6 Jun 1842] (JE00000021 – hb. Haussknecht [two specimens of a single gathering]); "Herb. E. Boissier / *Anoplanthus Biebersteinii* Reut. / β *Boissieri* Reut. / Mesogis [Messogis Mountains / Mesogis Mountains, Aydın Dağları (ancient Lydia), near Aydın / Güzelhisar / Tralles, Aydın Province] et Cadmus [Mount Cadmus / Topçambaba Dağı / Baba Dağı / Baba Dagh, Aydın Province? or mont Honaz / mont Cadmus / Honaz Dağı, Denizli Province?] / Jun. 1842" (P02970934 - Boissier 1842 [the three specimens of a single gathering on the lower right corner close to Boissier's label]); idem (P02970938 – hb. E. Cosson [the two specimens of a single gathering on the upper left corner close to Boissier's label]).

Isosyntypes: 1. "Caria [Karia], *C. Pinard*, 1843". – 2. "Syntypes / *Anoplanthus biebersteinii* / var. *boissieri* Reut." (G-Boiss G00150149 [two specimens of a single gathering, which are attached to its host-plant]); 1. "Caria [Karia], *C. Pinard*, 1843". – 2. "*A. Biebersteinii*". – 3. "*Anoplanthus Biebersteinii* Reut. / in DC. prod. 11 p. 42 / *Phelipaea biebersteinii* Fisch. / *Anoplon* — C.A. Mey. / *Orobanche coccinea* Pers. / *Lathraea phelipaea* β Linn. / — β. *Boissieri* Reut. in DC. prod.". – 4. "Syntypes / *Anoplanthus biebersteinii* / var. *boissieri* Reut." (G00096074 - hb. Reuter-Barbey [Fig. 2, three specimens of a single gathering, two of them are attached to their host-plant])).

Homotypic synonyms: *Diphelypaea boissieri* (Reut.) Nicolson in Taxon, 24 (5–6): 654 (1975), nom. illeg.

Phelypaea coccinea var. *boissieri* (Reut.) Beck in Engl., Pflanzenr. 96: 43 (1930)

Diphelypaea coccinea var. *boissieri* (Reut.) Uhlich in Kochia 9: 83 (2015), nom. illeg.

Heterotypic synonyms: *Anoplanthus coccineus* var. *nigrovittatus* Boiss., Fl. Orient. 4(2): 494 (1879 [Apr-May 1879]) ["A. coccineus γ nigrovittatus"] (Stapf 1915: 290, 293). *Ind. loc.:* "Hab. in graminosis montis Pir Omar Gudrum [Chiya-i Piromar / Chiyā-i Pīrōmar / Jabal Biru Mar / Jabal Bīrū Mār / Pīr `Umar, Bīrūmā / Piromar / Pīrōmar, Iraqi Kurdistan, Iraq] 5–6000' (*Haussk* !)". *Lectotype* (designated here, or perhaps holotype): 1. "711 / *Anoplanthus Biebersteinii* Reuter / fl sanguin., vitta nigra lata / In gramin. 5-6000' / Haussknecht, It. Orient, Pir Omar Gudrum. Jun. — 1867". – 2. "*A. coccineus* γ *vittatus*". – 3. "*Anoplanthus coccineus* γ *vittatus*" (G-BOIS G00768924 - n° SIB 436114/1 (Stapf 1915: 293) [five specimens of a single gathering]).

Phelypaea coccinea var. *boissieri* f. *septemfida* Gilli in Feddes Repert. 46: 47 (1939) ["Calyx irregulariter septemfidus"]. *Ind. loc.:* "Nord-Iran [Iran / Persia]: Nördlich vom Kendewan-Paß [Kendavan Pass / Gardaneh-ye Kandovān, 36°9'0"N, 51°18'0"E, Māzandarān, Alborz / Alburz / Elburz / Elborz Mountains] an einem Abhang unweit des Tunnelbaues, 1800 m; 8.VII.1936."

The species typified here was described by Reuter, with the rank of var., on the basis of collections made in western Anatolia (Turkey): Mount Cadmus by Boissier

Figure 1. Lectotype and isolectotype (G00150150 - G-Boiss) of *Phelypaea boissieri*.

copyright reserved
cm
Leg. C. Pinard
A. Bieberstenii
syn-TYPUS
Anoplanthus bieberstenii
var. boissieri Reut.
HERBIER REUTER-BARBEY
Herbier personnel de G. F. Reuter (1805-1872) acquis ensuite par W. Barbey et donné par ce dernier en 1919 à l'Institut de botanique de l'Université de Genève. Transféré aux Herbiers de la Ville de Genève, il fut intercalé dans la collection générale dès 1966.
HERBARIUM GENAVENSE (G)
G00096074

Figure 2. Isosyntype (G00096074 - hb. Reuter-Barbey) of *Phelypaea boissieri*.

and Caria by Pinard (Reuter 1847: 42). Later, Boissier (1879: 494) included it within his *Anoplanthus coccineus*, which would be the origin of future confusions between the two species. In addition, he described two new varieties, the var. *peduncularis* (*P. tournefortii* Desf.) and the var. *nigrovittatus* (*P. boissieri* (Reut.) Stapf). Stapf (1915) raised the variety of Reuter to the rank of species and clarified the differences between the three taxa, so that nowadays we believe that they form this genus. Beck (1930), in a monograph on the family, preferred to continue treating our species with the rank of var. within *P. coccinea*, but created some confusion when giving the distribution of this species where he included the var. described by Reuter. Finally, Cullen (2010) complements the description of *P. boissieri*, giving good illustrations with analysis, providing a new key for the three species, and indicating the distribution of the species treated here.

A new form of *Phelypaea boissieri*

***Phelypaea boissieri* f. *lutea* Ü. Subasi, R. Piwowarczyk, Ó. Sánchez Pedraja, f. nov.**
Figure 3

Diagnosis. This new taxon is very similar to typical *Phelypaea boissieri*, and is compliant with morphometric characteristics in the description of the plant after Reuter (1847: 42, sub *Anoplanthus biebersteinii* var. *boissieri*), Stapf (1915), Nicolson (1975), Cullen (2010) but differs significantly in color and, usually, a higher stem. In typical *P. boissieri*, flowers are deeply red, and stem, calyx and scales are red to brown, or rarely pale-brown, whereas in the f. *lutea* corolla, calyx, and scales are yellow to orange with black folds in the corolla, with only the stem being brownish (Fig. 3).

Type. Turkey. C10 Hakkâri: Merkez district, Kırıkdağ village, Gümüşlü location (Kurdish: Spixane). Cilo Mountains, subalpine grasslands and meadows, ca. 2,470 m alt., 10 June 2021, *Ü. Subaşı* s.n. (holotype and isotypes ANK!).

Distribution and ecology. This taxon is known exclusively from the type locality. The Cilo (Glacial) Mountains (Cilo (Buzul) Dağı) are part of the Hakkâri Dağları range and include the third highest peak of Turkey with an altitude of 4,135 meters. Turkey's Eastern Anatolia Region, the easternmost extension of the Southeast Taurus Mountains, is located within the borders of Hakkari province. The locality of *P. boissieri* f. *lutea* is located in Hakkari province, Kırıkdağ village, Gümüşlü location (Kurdish: Spixane). This area is located around Mt Uludoruk (Reşko 4,135 m), at an altitude of approximately 2,470 meters. In this area dominated by high mountain steppe plants, the bedrock consists mainly of tectonic deposits and limestone. It is approximately 20 km from any settlements. Parasitising *Centaurea*, probably *C. persica* Boiss. (new host-plant). Phenology - flowering end of June to July, fruiting July to August. The population size is small, over a dozen individuals. The number of individuals counted in the area is fewer than 100. The entire population in this locality is formed by higher plants than the type with yellow corolla. In the future, research into the cause, phytochemical composition, ecological importance and adaptation, and

Figure 3. Habitat and general habit of *Phelypaea boissieri* f. *lutea* at 2,470 m alt. in Cilo Mountains, Hakkari province, SE Turkey. Phot. Ü. Subaşı.

also into pollinators of typical red *Phelypaea* individuals and yellow-orange ones could shed new light on this topic.

Etymology. The form name originated from the yellow to orange colouring of plants.

Note. There are also photos of a yellow flower belonging to *P. boissieri* in Internet sources [https://www.flickr.com/photos/camerar/2887571252/ and http://www.agaclar.net/forum/1296397-post1573.htm]. The photos, respectively, were taken in SE Turkey by Karen Nichols in 26 June 2008, possibly in the same Hakkari province, but no more detailed location data is available, and Hakkari-Mergan-Yaylası (Mergan Plateau) by Güngör Salman in 16 June 2014 [http://www.agaclar.net/forum/1296397-

post1573.htm], as well as from Yüksekova/Hakkari by Leoš Smutný in 13 May 2014 [https://www.inaturalist.org/observations/71616618]. We are also aware of a near mention ("Yüksekova [Gever / Gawar], 1950 m, 23 v 1966, *Eiselt*!") (Gilli 1982: 2, sub *P. coccinea*); this record probably corresponds to the same f. previously described.

Acknowledgements

The authors thank the curators of herbaria (ANK, JE, P and very especially to G) and other individuals who kindly made their data on the species available. This work was partially financed by the Research Projects of the Jan Kochanowski University in Kielce no. SUPB. RN.21.244 (2020–2021) for Renata Piwowarczyk.

References

Beck G (1930) Orobanchaceae L. In: Engler A (Ed.) Das Pflanzenreich IV. 261 (Heft 96). Wilhelm Engelmann, Leipzig, 348 pp.

Boissier PÉ (1879) Flora orientalis [...] Volumen quartum. Fasciculus secundus. Genevae et Basileae.

Cullen J (2010) *Phelypaea boissieri*: Orobanchaceae. Curtis's Botanical Magazine 26(4): 379–388. https://doi.org/10.1111/j.1467-8748.2009.01673.x

Gilli A (1939) Neue Arten und Varietäten aus dem Elbursgebirge in Nord-Iran. Feddes Repert 46: 43–48. https://doi.org/10.1002/fedr.4870432203

Gilli A (1982) Orobanchaceae (90). In: Davis PH (Ed.) Flora of Turkey 7. Edinburgh, 1–22.

Nicolson DH (1975) *Diphelypaea* (Orobanchaceae), nom. nov. and other cauterizations on a nomenclatural hydra. Taxon 24(5–6): 651–657. https://doi.org/10.2307/1220740

Novopokrovsky IV, Tzvelev NN (1958) Orobanchaceae Lindl. In: Schischkin BK (Ed.) Flora URSS (Flora Unionis Republicarum Socialisticarum Sovieticarum) Vol. 23. Academiae Scientiarum URSS, Mosqua et Leningrad, 19–117. [In Russian]

Piwowarczyk R, Sánchez Pedraja Ó, Moreno Moral G, Fayvush G, Zakaryan N, Kartashyan N, Aleksanyan A (2019) Holoparasitic Orobanchaceae (*Cistanche*, *Diphelypaea*, *Orobanche*, *Phelipanche*) in Armenia: Distribution, habitats, host range and taxonomic problems. Phytotaxa 386(1): 1–106. https://doi.org/10.11646/phytotaxa.386.1.1

Piwowarczyk R, Ochmian I, Lachowicz S, Kapusta I, Sotek Z (2020) Phytochemical and bioactive properties of *Phelypaea tournefortii* – effect of parasitic lifestyle and environmental factors. Acta Universitatis Cibiniensis. Series E: Food Technology 24(1): 113–128. https://doi.org/10.2478/aucft-2020-0010

Piwowarczyk R, Schneider AC, Góralski G, Kwolek D, Denysenko-Bennett M, Burda A, Ruraż K, Joachimiak AJ, Sánchez Pedraja Ó (2021) Phylogeny and historical biogeography analysis support Caucasian and Mediterranean centres of origin of key holoparasitic Orobancheae (Orobanchaceae) lineages. PhytoKeys 174: 165–194. https://doi.org/10.3897/phytokeys.174.62524

Reuter G (1847) Orobanchaceae. In: De Candolle A (Ed.) Prodromus Systematis naturalis regni vegetabilis... 11: 1–45. [Addenda et Corrigenda: 717–720. Parisiis: Sumptibus Victoris Masson]. (TL-2: 446 n. 999). https://doi.org/10.5962/bhl.title.286

Sánchez Pedraja Ó, Moreno Moral G, Carlón L, Piwowarczyk R, Laínz M, Schneeweiss GM (2016) [continuously updated]. Index of Orobanchaceae. Liérganes, Cantabria, Spain. ISSN: 2386–9666 [accessed: October 2021]. http://www.farmalierganes.com/Otrospdf/publica/Orobanchaceae%20Index.htm

Stapf O (1915) The Genus Phelipaea. Bull. Misc. Inform. Kew 1915(6): 285–295. https://doi.org/10.2307/4104573